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THE DIGESTIBILITY OF THE DASHEEN.

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INTRODUCTION.

The dasheen, with other varieties of the taro (*Colocasia esculenta*), is a staple article of food for millions of people in tropical countries, the large, starchy tubers being ground and used like flour, cooked like potatoes, or prepared in a special way like the Hawaiian poi. Until recently these roots have been little known in this country, but of late the Department of Agriculture has given considerable attention to the selection of varieties suited to the warm localities where white potatoes do not grow well.[1] As a result, it has been found that the dasheen may be profitably grown, and attempts are being made to include it in the dietary as a starchy vegetable. Because its flavor and uses are so similar to those of the white potato, the dasheen will no doubt serve as a crop to supplement the potato supply, especially in regions where it will thrive and the potato can not be successfully grown.

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[1] U. S. Dept. Agr., Bur. Plant Indus. 1110 (1914).

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The tuber system of the dasheen consists of a large rootstock, or corm, and a considerable number of smaller cormels, or tubers, which branch out from the corm on all sides. The central corm may weigh from 1 to 5 or even 6 pounds. The tubers resemble sweet potatoes in shape and range of size. Inasmuch as both the corms and the tubers are edible and both are included in the harvested crop, throughout this discussion the term dasheen may be understood to refer to both.

Many tests of the culinary possibilities of the dasheen have been made by the Department of Agriculture, by home-economics workers and teachers, and by housekeepers. The general conclusion drawn from this work was very favorable to the dasheen. In general it may be said that the dasheen, which in flavor and starch is like the white potato, can be cooked in much the same way as this well-known vegetable. The flesh of the dasheen, when cooked, varies from a white or gray to a light-violet color and has a nutty flavor, which is very generally relished by those who are accustomed to it. It seems drier than white potato and many seem to feel the need for a liberal amount of butter when eating it, either baked or boiled.

A review of the literature furnished no information in regard to the digestibility of this vegetable, and so it seemed desirable to determine to what extent it is utilized by the human body. A supply of dasheens of uniform quality, grown under known soil and climatic conditions, was secured for this purpose through the cooperation of the Bureau of Plant Industry from one of its experimental fields in Florida.

NATURE OF THE DIET DURING THE TEST PERIODS.

Since carbohydrates would be the chief nutrient introduced into the diet by the dasheen, in this study attention has centered on the digestibility of this constituent, though data are also reported for protein, fat, and ash. Accordingly, in selecting the basal ration, foods were chosen which contained a minimum amount of carbohydrates, a simple basal diet consisting of milk, fruit, butter, and tea or coffee, if any liquid other than water was desired, being served in conjunction with the dasheen. The object was to have a diet simple in character and meeting the experimental requirements, yet sufficiently palatable to be eaten for three days (the length of the experimental periods) without being monotonous, and also varied enough to be comparable with an ordinary mixed diet. That experimental rations thus planned give satisfactory results has been the experience of this office. To insure the consumption of fairly large amounts of dasheen the subjects were urged to eat freely of it, and at the same time they were not restricted with respect to the amounts of the accessary foods eaten. As a result the amounts of food eaten during the different test periods varied quite materially.

SUBJECTS.

The subjects who assisted in this investigation were strong, healthy men, with normal appetites and digestive functions, whose ages varied from 20 to 40 years. With one exception they were all students in local institutions. Since all had more or less muscular exercise, it seems fair to regard them as engaged in light muscular work rather than as of sedentary occupation. Their normal dietary was simple and, except that it contained meat, was not materially different from that of the experimental periods and, accordingly, the change from one type of diet to the other was not accompanied by any noticeable physiological disturbances. The subjects were instructed to submit a report of their physical condition during the experimental period and in every instance they stated that they were in normal condition. Inasmuch as this study of the dasheen was primarily concerned with the coefficients of digestibility, no attempt was made to maintain a uniform body weight and no record was kept of the weight of the subjects. The ration for each subject was prepared and weighed in advance. They were instructed to reserve any uneaten portions of the diet for analysis, and how to collect feces resulting from the experimental diet.

RELATION BETWEEN MATURITY AND DIGESTIBILITY.

In addition to considering the general question of digestibility it seemed desirable also to determine whether or not maturity of the dasheen influenced their digestibility. Obviously, for this purpose dasheens were needed which were as nearly alike as possible except in respect to maturity at the time of harvesting. The Office of Foreign Seed and Plant Introduction of the Bureau of Plant Industry, accordingly provided representative samples of immature and mature dasheens grown under controlled conditions at the plant introduction field station, Brooksville, Fla. Rows which were adjudged to be typical of the field were chosen, and about six weeks before the usual harvesting time the alternate plants were harvested and their entire root systems forwarded to this laboratory as were also the tubers of the remaining plants when later they were considered to be mature. The tubers in both cases were eaten less than a week after being removed from the ground.

Experiments Nos. 513, 514, and 519 to 522 report results obtained with the immature dasheen, while the remaining four experiments (Nos. 543 to 546) are concerned with the digestibility of the mature tubers. All experimental conditions were maintained as nearly identical as possible in both sets of experiments, and, accordingly, the results reported should be directly comparable.

DETAILS OF THE EXPERIMENTS.

In general, the methods employed in this investigation were the same as those for similar experiments reported in recent publications[1] of this office. Considerable care was exercised in preparing and serving the experimental diet so that all the foods eaten by the different subjects at the different meals should be of uniform composition. The accessory foods (milk, fruit, butter) were so chosen and prepared as to be quite uniform in composition; they were eaten as purchased and were not cooked in any way.

The dasheen, in sufficient quantities to supply all the subjects for the entire period of each experiment, was prepared at the beginning of the test period. In every case it was parboiled until the outer portion could be pierced with a fork, and then baked until the center of the tubers was thoroughly softened, a method of preparation which experience has shown to be satisfactory as regards quality and economy of time and which is in accord with a common practice. The entire tuberous structure of the plants was used in every case. As was to be expected, it was found that the time required for baking the large corms was considerably greater than that necessary for the smaller cormels or tubers. When thoroughly baked, the thick skin was removed at once and the dasheens were passed through a potato ricer while still hot, since they do not " rice " well when cool. They were then thoroughly mixed to insure uniformity and for each test a representative sample was reserved for analysis. The 10 experiments here reported occurred at three intervals—two experiments (Nos. 513 and 514), beginning September 28; four experiments (Nos. 519 to 522), beginning October 10; and four experiments (Nos. 543 to 546), beginning November 22. The subjects were permitted to warm the dasheen before eating it if they so desired, but when they did so they were required to leave none uneaten. Butter was eaten with the dasheen, each man using, on an average, approximately 110 grams of butter daily, equivalent to 90 grams or more of butter fat.

The separation of the feces resulting from the diet was accomplished by means of lampblack taken in gelatin capsules with the first meal of the experimental period and with the first meal succeeding the test period; the resulting dark coloration of a portion of the feces makes it possible, generally, to separate very accurately the feces from the experimental diet from the remainder voided at the same time. The feces for each experiment were deposited in tared glass containers and were dried in an electric oven regulated to maintain a temperature of 95° C. When dry, the total amount of feces for each subject was finely ground and thoroughly mixed for analysis. Samples of both food and feces, the latter reported on "water-free" basis, were analyzed to determine the percentages of protein, fat, and carbohydrates, according to the methods outlined by the Association of Official Agricultural Chemists,[1] and from a comparison of the results it was determined how much was actually digested.

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[1] See list on p. 12.

The data essential for the interpretation of the results of the digestion experiments are given in the tables below, and include the total amount of food eaten, the amounts of protein, fat, and carbohydrates supplied, the weights of the feces and their constituents, and the coefficients of digestibility of the protein, fat, and carbohydrates of the diet.

EXPERIMENTS WITH IMMATURE DASHEENS.

Six experiments were made with immature dasheens and, while these were not all carried on at the same time, the subjects and all experimental conditions were the same throughout. The results are given in the following table:

Data of digestion experiments with immature dasheens in a simple mixed diet.

Food.	Total.	Water.	Protein.	Fat.	Carbohydrates.	Ash.
Experiment No. 513, subject A. J. H.:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dasheen	1,430.0	983.1	24.2	2.3	406.4	14.0
Milk	2,530.0	2,201.1	75.9	101.2	126.5	25.3
Fruit	131.0	113.8	1.0	0.3	15.2	0.7
Butter	482.0	53.0	4.8	409.7	....	14.5
Total food consumed	4,573.0	3,351.0	105.9	513.5	548.1	54.5
Feces	98.0	....	33.4	30.6	17.7	16.3
Amount utilized	....	....	72.5	482.9	530.4	38.2
Per cent utilized	....	....	68.5	94.0	96.8	70.1
Experiment No. 514, subject P. K.:						
Dasheen	1,599.0	1,099.3	27.0	2.6	454.4	15.7
Milk	2,363.0	2,055.8	70.9	94.5	118.2	23.6
Fruit	741.0	643.9	5.9	1.5	86.0	3.7
Butter	340.0	37.4	3.4	289.0	....	10.2
Total food consumed	5,043.0	3,836.4	107.2	387.6	658.6	53.2
Feces	34.0	....	10.0	8.2	10.6	5.2
Amount utilized	....	....	97.2	379.4	648.0	48.0
Per cent utilized	....	....	90.7	97.9	98.4	90.2

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[1] U. S. Dept. Agr., Bur. Chem. Bul. 107 (1912), rev. ed.

Data of digestion experiments with immature dasheens in a simple mixed diet—Continued.

Food.	Total.	Water.	Protein.	Fat.	Carbohydrates.	Ash.
Experiment No. 519, subject H. R. G.:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dasheen	1,900.0	1,291.0	40.5	2.7	546.2	19.6
Milk	2,625.0	2,283.8	78.7	105.0	131.3	26.2
Fruit	373.0	324.1	3.0	0.7	43.3	1.9
Butter	153.0	16.8	1.5	130.1		4.6
Total food consumed	5,051.0	3,915.7	123.7	238.5	720.8	52.3
Feces	71.0		30.9	10.6	18.0	11.5
Amount utilized			92.8	227.9	702.8	40.8
Per cent utilized			75.0	95.6	97.5	78.0
Experiment No. 520, subject A. J. H.:						
Dasheen	1,335.0	907.1	28.4	1.9	383.8	13.8
Milk	2,702.0	2,350.7	81.1	108.1	135.1	27.0
Fruit	68.0	59.1	0.6	0.1	7.9	0.3
Butter	356.0	39.2	3.5	302.6		10.7
Total food consumed	4,461.0	3,356.1	113.6	412.7	526.8	51.8
Feces	65.0		22.8	10.0	20.5	11.7
Amount utilized			90.8	402.7	506.3	40.1
Per cent utilized			79.9	97.6	96.1	77.4
Experiment No. 521, subject P. K.:						
Dasheen	1,960.0	1,331.8	41.8	2.7	563.5	20.2
Milk	2,610.0	2,270.7	78.3	104.4	130.5	26.1
Fruit	839.0	729.1	6.7	1.7	97.3	4.2
Butter	458.0	50.4	4.6	389.3		13.7
Total food consumed	5,867.0	4,382.0	131.4	498.1	791.3	64.2
Feces	61.0		19.4	18.0	12.2	11.4
Amount utilized			112.0	480.1	779.1	52.8
Per cent utilized			85.2	96.4	98.5	82.2
Experiment No. 522, subject C. J. W.:						
Dasheen	2,194.0	1,490.8	46.7	3.1	630.8	22.6
Milk	2,549.0	2,217.6	76.5	102.0	127.4	25.5
Fruit	966.0	839.5	7.7	1.9	112.1	4.8
Butter	164.0	18.1	1.6	139.4		4.9
Total food consumed	5,873.0	4,566.0	132.5	246.4	870.3	57.8
Feces	68.0		26.5	10.2	19.0	12.3
Amount utilized			106.0	236.2	851.3	45.5
Per ecnt utilized			80.0	95.9	97.8	78.7
Average food consumed per subject per day	1,714.9	1,300.4	39.7	127.6	228.7	18.5

Summary of digestion experiments with immature dasheens in a simple mixed diet.

Experiment No.	Subject.	Protein.	Fat.	Carbohydrates.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
513	A. J. H.	68.5	94.0	96.8	70.1
514	P. K.	90.7	97.9	98.4	90.2
519	H. R. G.	75.0	95.6	97.5	78.0
520	A. J. H.	79.9	97.6	96.1	77.4
521	P. K.	85.2	96.4	98.5	82.2
522	C. J. W.	80.0	95.9	97.8	78.7
Average		79.9	96.2	97.5	79.4

The variations which occurred in the results obtained in the two sets of experiments were immaterial. Furthermore, the results of the individual experiments agree quite closely with one another with respect to the figures commonly reported for the carbohydrates.

During these six tests the subjects ate on an average 40 grams of protein, 128 grams of fat, and 229 grams of carbohydrates, which were 79.9 per cent, 96.2 per cent, and 97.5 per cent digested, respectively. These values indicate a very complete utilization of this diet by the human body.

EXPERIMENTS WITH MATURE DASHEENS.

The results of four experiments with mature dasheens are given in the following table:

Data of digestion experiments with mature dasheens in a simple mixed diet.

Food.	Total.	Water.	Protein.	Fat.	Carbohydrates.	Ash.
Experiment No. 543, subject H. R. G.:	*Gr.*	*Gr.*	*Gr.*	*Gr.*	*Gr.*	*Gr.*
Dasheen	1,128.0	719.6	27.5	2.8	367.2	10.9
Milk	2,604.0	2,265.5	78.1	104.2	130.2	26.0
Fruit	462.0	401.5	3.7	.9	53.6	2.3
Butter	143.0	15.7	1.4	121.6	....	4.3
Total food consumed	4,337.0	3,402.3	110.7	229.5	551.0	43.5
Feces	59.0	....	22.4	10.4	15.5	10.7
Amount utilized	....	....	88.3	219.1	535.5	32.8
Per cent utilized	....	....	79.8	95.5	97.2	75.4
Experiment No. 544, subject A. J. H.:						
Dasheen	1,247.0	795.5	30.4	3.1	405.9	12.1
Milk	2,897.0	2,520.4	86.9	115.9	144.8	29.0
Fruit	95.0	82.5	.8	.2	11.0	.5
Butter	436.0	48.0	4.3	370.6	....	13.1
Total food consumed	4,675.0	3,446.4	122.4	489.8	561.7	54.7
Feces	52.0	....	15.4	24.4	3.3	8.9
Amount utilized	....	....	107.0	465.4	558.4	45.8
Per cent utilized	....	....	87.4	95.0	99.4	83.7
Experiment No. 545, subject P. K.:						
Dasheen	1,848.0	1,178.9	45.1	4.6	601.5	17.9
Milk	2,942.0	2,559.5	88.3	117.7	147.1	29.4
Fruit	849.0	737.8	6.8	1.7	98.5	4.2
Butter	490.0	53.9	4.9	416.5	....	14.7
Total food consumed	6,129.0	4,530.1	145.1	540.5	847.1	66.2
Feces	57.0	....	17.2	16.5	12.5	10.8
Amount utilized	....	....	127.9	524.0	834.6	55.4
Per cent utilized	....	....	88.1	96.9	98.5	83.7
Experiment No. 546, subject C. J. W.:						
Dasheen	1,763.0	1,124.6	43.0	4.4	573.9	17.1
Milk	2,945.0	2,562.1	88.4	117.8	147.2	29.5
Fruit	1,048.0	910.7	8.4	2.1	121.6	5.2
Butter	236.0	26.0	2.3	200.6	....	7.1
Total food consumed	5,992.0	4,623.4	142.1	324.9	842.7	58.9
Feces	110.0	....	38.2	13.9	37.1	20.8
Amount utilized	....	....	103.9	311.0	805.6	38.1
Per cent utilized	....	....	73.1	95.7	95.6	64.7
Average food consumed per subject per day	1,761.1	1,333.5	43.4	132.1	233.5	18.6

Summary of digestion experiments with mature dasheen in a simple mixed diet.

Experiment No.	Subject.	Protein.	Fat.	Carbohydrates.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
543	H. R. G.	79.8	95.5	97.2	75.4
544	A. J. H.	87.4	95.0	99.4	83.7
545	P. K.	88.1	96.9	98.5	83.7
546	C. J. W.	73.1	95.7	95.6	64.7
Average		82.1	95.8	97.7	76.9

In the experiments with mature dasheens the subjects ate, on an average, 41 grams of protein, 129 grams of fat, and 231 grams of carbohydrates, of which 82.1 per cent, 95.8 per cent, and 97.7 per cent, respectively, were retained in the body. These values, except for protein, agree quite closely with those reported for an ordinary mixed diet,[1] which are, for protein, 92 per cent; for fat, 95 per cent; and for carbohydrates, 97 per cent. Perhaps the low coefficient of digestibility of the protein obtained may be due to the fact that only 41 grams were taken per man per day; it has long been recognized that the feces contain nitrogen aside from that derived from the diet, and this becomes proportionately larger as the nitrogen intake decreases. The coefficient of digestibility obtained for the carbohydrates of the mature dasheen, 97.7 per cent, would indicate that they are very well assimilated.

SUMMARY OF ALL EXPERIMENTS.

The following table summarizes the results of all the experiments reported:

Summary of all digestion experiments with dasheens in a simple mixed diet.

Experiment No.	Subject.	Protein.	Fat.	Carbohydrates.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
513	A. J. H.	68.5	94.0	96.8	70.1
514	P. K.	90.7	97.9	98.4	90.2
519	H. R. G.	75.0	95.6	97.5	78.0
520	A. J. H.	79.9	97.6	96.1	77.4
521	P. K.	85.2	96.4	98.5	82.2
522	C. J. W.	80.0	95.9	97.8	78.7
543	H. R. G.	79.8	95.5	97.2	75.4
544	A. J. H.	87.4	95.0	99.4	83.7
545	P. K.	88.1	96.9	98.5	83.7
546	C. J. W.	73.1	95.7	95.6	64.7
Average		80.8	96.1	97.6	78.4

The average amount of food consumed per subject per day in all experiments was 1,733.4 grams, furnishing 1,313.6 grams of water, 41.2 grams of protein, 129.4 grams of fat, 230.6 grams of carbohydrates, and 18.6 grams of ash.

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[1] Connecticut Storrs Sta. Rpt. 1901, p. 245.

DISCUSSION OF RESULTS.

The amount of dasheen eaten during the test periods varies from an average of 376 grams per man per day in experiment No. 543 to an average of 731 grams per man per day in experiment No. 522, the general average for the 10 experiments being 547 grams per man per day.

Considering the 10 experiments with both the immature and mature dasheen together (see p. 8), it will be seen that, on an average, 41 grams of protein, 129 grams of fat, and 231 grams of carbohydrates were eaten per man per day, of which 80.8 per cent of the protein, 96.1 per cent of the fat, and 97.6 per cent of the carbohydrates supplied by the total diet were digested.

The coefficient of digestibility of the fat (99 per cent of which was butter fat) furnished by the diet is not without interest. The reported value, 96.1 per cent, approximates the value (97 per cent) obtained in a study of the digestibility[1] of butter, in which the diet was of an entirely different nature, namely, blancmange (containing large amounts of butter), wheat biscuit, fruit, and tea or coffee with sugar. In a later investigation,[2] in which butter supplied the greater proportion of the fat of a diet of still different nature (hard palates of cattle served in the form of a meat loaf, containing butter, potato, crackers, and sugar), butter fat was found to be 95 per cent digested. The amounts of butter fat eaten per subject per day in the experiments with dasheen, with butter, and with hard palates were 128 grams, 97 grams, and 106 grams, respectively. This agreement between the values determined for the digestibility of butter, when eaten with different types of diets and under identical experimental conditions, furnishes additional basis for the belief that a fat included in a mixed diet is digested equally well regardless of the nature of the other constituents of the diet.

As regards the amounts of nutrients supplied by dasheens of different maturity, it will be seen that in the six experiments with the immature dasheen an average of 40 grams of protein, 128 grams of fat, and 229 grams of carbohydrates was eaten per man per day, while in the four experiments with the mature dasheen the average amounts were for all practical purposes identical, being 43 grams of protein, 132 grams of fat, and 234 grams of carbohydrates daily.

The average coefficient of digestibility of the carbohydrates of immature and of mature dasheens was 97.5 per cent and 97.7 per cent, respectively. Apparently in so far as the thoroughness of digestion of the dasheen carbohydrates is concerned, it would seem immaterial whether the well-grown dasheen is mature or immature when harvested.

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[1] U. S. Dept. Agr. Bul. 310 (1915), p. 21.

[2] U. S. Dept. Agr., Jour. Agr. Research, 6 (1916), No. 17, p. 647.

The difference in the amounts of carbohydrates supplied by the total diet eaten per subject per day in the various tests was quite large, varying from a minimum of 176 grams in experiment No. 520 to a maximum of 290 grams in experiment No. 522, with an average daily consumption of 231 grams. On the whole, the differences in the values obtained for the digestibility of the carbohydrates with the different subjects in the different tests is small, and such variations as were found in the digestibilty of the carbohydrates did not correspond to observed variations in the amounts of carbohydrates eaten.

Comparing the average value found for the digestibility of the carbohydrates of the dasheen, 97.6 per cent, with that reported for the carbohydrates of the potato, no significant difference is found. Bryant and Milner[1] on the basis of three experiments report the digestibility of potato carbohydrates to be 99.0 per cent; in an experiment reported by Rubner[2] the coefficient of digestibility was 92.4 per cent; while Constantinidi[3] found that an average of 99.6 per cent of the potato carbohydrates was utilized by the human body.

CONCLUSIONS.

In 10 digestion experiments with men, mature and immature dasheens were eaten in conjunction with common food materials in a simple mixed diet. The average coefficients of digestibility for the total diet were: Protein, 80.8 per cent; fat, 96.1 per cent; and carbohydrates, 97.6 per cent.

The value obtained for the digestibility of the carbohydrates, 97.6 per cent, which for all practical purposes represents the digestibility of the dasheen carbohydrates, compares very favorably with that of potatoes, the common vegetable most resembling the dasheen.

The subjects of their own volition ate on an average approximately 1¼ pounds of dasheen daily without any observed physiological disturbances, which would indicate that considerable amounts of dasheens may be safely used in the dietary and that they are palatable.

The results here reported were obtained from dasheens cooked by one method only; in the absence of data to the contrary it may be very well assumed that the dasheen is equally well digested when prepared by other methods similar to those employed with potatoes.

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[1] Amer. Jour. Physiol., 10 (1903), No. 2, p. 96.
[2] Ztschr. Biol., 15 (1879), No. 1, p. 148.
[3] Ztschr. Biol., 23 (1887), p. 449.

The data obtained in this investigation give evidence to justify the belief that the dasheen is a valuable addition to the dietary, that it can replace the potato in those regions where the potato can not be successfully grown or easily obtained, and that it is also valuable for more general use to give greater variety to the diet in other localities.

PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RELATING TO FOOD AND NUTRITION.

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

Meats: Composition and Cooking. By Chas. D. Woods. Pp. 31, figs. 4. 1904. (Farmers' Bulletin 34.)

The Use of Milk as Food. By R. D. Milner. Pp. 44. 1911. (Farmers' Bulletin 363.)

Care of Food in the Home. By Mrs. Mary Hinman Abel. Pp. 46, figs. 2. 1910. (Farmers' Bulletin 375.)

Economical Use of Meat in the Home. By C. F. Langworthy and Caroline L. Hunt. Pp. 30. 1910. (Farmers' Bulletin 391.)

Cheese and Its Economical Uses in the Diet. By C. F. Langworthy and Caroline L. Hunt. Pp. 40. 1912. (Farmers' Bulletin 487.)

Mutton and Its Value in the Diet. By C. F. Langworthy and Caroline L. Hunt. Pp. 32, figs. 2. 1913. (Farmers' Bulletin 526.)

The Detection of Phytosterol in Mixtures of Animal and Vegetable Fats. By R. H. Kerr. Pp. 4. 1913. (Bureau of Animal Industry Circular 212.)

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

Experiments on Losses in Cooking Meat, 1900–1903. By H. S. Grindley, D. Sc., and Timothy Mojonnier, M. S. Pp. 95, tables 82. 1904. (Office of Experiment Stations Bulletin 141.) Price, 5 cents.

Studies on the Influence of Cooking upon the Nutritive Value of Meats at the University of Illinois, 1903–1904. By H. S. Grindley, D. Sc., and A. D. Emmett, A. M. Pp. 230, tables 136. 1905. (Office of Experiment Stations Bulletin 162) Price, 20 cents.

Studies of the Effect of Different Methods of Cooking upon the Thoroughness and Ease of Digestion of Meats at the University of Illinois. H. S. Grindley, D. Sc., Timothy Mojonnier, M. S., and Horace C. Porter, Ph. D. Pp. 100, tables 38. 1907. (Office of Experiment Stations Bulletin 193.) Price, 15 cents.

Digestibility of Some Animal Fats. By C. F. Langworthy and A. D. Holmes. Pp. 23. 1915. (Department Bulletin 310.) Price, 5 cents.

Digestibility of Very Young Veal. By C. F. Langworthy and A. D. Holmes. Pp. 577–588. 1916. (Journal of Agricultural Research, 6 (1916), No. 16.) Price, 5 cents.

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